

2.10, or 1.55 below normal; the greatest monthly amount, 3.54, occurred at Billingsport Lighthouse, and the least, 1.13, at the College Farm, New Brunswick.—*E. W. McGann.*

New Mexico.—The mean temperature was 69.2°, or about 4.0° below normal; the highest was 106°, at Albert on the 25th, and the lowest, 23°, at Buckmans on the 3d. The average precipitation was 2.12, or 0.25 below normal; the greatest monthly amount, 6.05, occurred at Roswell, and least, trace, at Deming.—*R. M. Hardinge.*

New York.—The mean temperature was 66.9°, or 1.3° above normal; the highest was 96°, at Poughkeepsie on the 15th, and the lowest, 32°, at Alfred, Bolivar, and South Canisteo on the 16th. The average precipitation was 2.74, or 0.76 below normal; the greatest monthly amount, 6.87, occurred at Humphrey, and the least, 0.62, at Setauket.—*R. G. Allen.*

North Carolina.—The mean temperature was 74.8°, or about 0.5° above normal; the highest was 104°, at Goldsboro on the 10th, and the lowest, 40°, at Linville on the 23d. The average precipitation was 3.41, or about 1.00 below normal; the greatest monthly amount, 7.32, occurred at Sloan, and the least, 0.70, at Springhope.—*C. F. von Herrmann.*

North Dakota.—The mean temperature was 62.5°, or 2.1° below normal; the highest was 105°, at Medora on the 18th, and the lowest, 26°, at Woodbridge on the 14th. The average precipitation was 2.69, or 1.15 below normal; the greatest monthly amount, 6.80, occurred at University, and the least, 0.68, at Ashley.—*B. H. Bronson.*

Ohio.—The mean temperature was 71.9°, or 1.5° above normal; the highest was 99°, at Seaman on the 7th, and the lowest, 39°, at Montpelier on the 3d, at Rittman on the 22d, and at Greenhill on the 23d. The average precipitation was 2.86, or 0.90 below normal; the greatest monthly amount, 7.05, occurred at Millport, and the least, 0.83, at New Bremen.—*H. W. Richardson.*

Oklahoma.—The mean temperature was 77.4°; the highest was 102°, at Jefferson and Newkirk on the 25th, and at Kemp on the 22d, and the lowest, 52°, at Waukomis on the 2d. The average precipitation was 4.64; the greatest monthly amount, 8.58, occurred at Pawhuska, and the least, 1.66, at Guthrie.—*J. I. Widmeyer.*

Oregon.—The mean temperature was 62.2°, or 1.7° above normal; the highest was 99°, at Pendleton on the 10th, and at Riverside on the 18th, and the lowest, 23°, at Prineville on the 27th. The average precipitation was 1.72, or 0.16 above normal; the greatest monthly amount, 9.75, occurred at Toledo, and the least, 0.24, at Lakeview.—*B. S. Pague.*

Pennsylvania.—The mean temperature was 69.6°, or slightly above normal; the highest was 100°, at Aqueduct on the 25th, and the lowest, 33°, at Shinglehouse on the 16th. The average precipitation was 2.79, or 1.31 below normal; the greatest monthly amount, 6.96, occurred at Elwood Junction, and the least, 0.56, at Reading.—*T. F. Townsend.*

South Carolina.—The mean temperature was 79.7°, or 2.2° above normal; the highest was 105°, at Gillisonville on the 29th, and the lowest, 55°, at Trenton on the 6th, and at Santuck on the 7th. The average precipitation was 4.15, or 0.47 below normal; the greatest monthly amount, 10.68, occurred at Pinopolis, and the least, 1.58, at Central.—*J. W. Bauer.*

South Dakota.—The mean temperature was 67.3°, or about normal; the highest was 113°, at Cherry Creek on the 22d, and the lowest, 30°, at

at Rochford on the 27th. The average precipitation was 2.16, or 1.62 below normal; the greatest monthly amount, 5.68, occurred at Canton, and the least, trace, at Interior.—*S. W. Glenn.*

Tennessee.—The mean temperature was 76.7°, or slightly above normal; the highest was 102°, at Elizabethton on the 10th, and the lowest, 44°, at Silverlake on the 23d. The average precipitation was 3.70, or considerably below normal; the greatest monthly amount, 7.02, occurred at Peryear, and the least, 1.41, at Andersonville.—*H. C. Bate.*

Texas.—The mean temperature for the State during the month, determined by comparison of 39 stations distributed throughout the State, was normal. There was a slight deficiency over the coast district, over the panhandle, and west Texas, with the greatest, 4.5°, in the vicinity of El Paso, while over the other portions of the State, the temperature was generally above the normal, with the greatest excess, 5.2°, in the vicinity of Brownwood. The highest was 104°, at Fort McIntosh on the 2d, 3d, and 4th, and the lowest, 40°, at Valentine on the 7th. The average precipitation for the State during the month, determined by comparison of 39 stations distributed throughout the State, was 1.78 above the normal. There was a slight deficiency along the coast, over west Texas, and in a few other localities, with the greatest deficit, 2.93, at Galveston, while over other portions of the State there was a general excess, ranging from 0.97 to 3.81 over east and north Texas and the panhandle, and from 1.02 to 5.99 over central and southwest Texas, with the greatest, 5.99, at Coleman; the greatest monthly amount, 10.85, occurred at Ballinger, and the least, 0.08, at Point Isabel.—*I. M. Cline.*

Utah.—The mean temperature was 65.2°; the highest was 110°, at Mount Pleasant on the 18th, and the lowest, 22°, at Soldier Summit on the 3d. The average precipitation was 0.78, or slightly above normal; the greatest monthly amount, 1.58, occurred at Tooele, and the least, 0.11, at Frisco.—*J. H. Smith.*

Virginia.—The mean temperature was 73.2°, or nearly normal; the highest was 104°, at Doswell on the 30th, and the lowest, 40°, at Burkes Garden on the 22d. The average precipitation was 2.85, or 0.83 below normal; the greatest monthly amount, 4.86, occurred at Bigstone Gap, and the least, 0.45, at Alexandria.—*E. A. Evans.*

Washington.—The mean temperature was 60.6°, or about 1.5° above normal; the highest was 103°, at Kennewick on the 10th, and the lowest, 28°, at Hunters on the 28th. The average precipitation was 2.38, or about 0.50 above normal; the greatest monthly amount, 8.56, occurred at Clearwater, and the least, 0.29, at Moxee.—*G. N. Salisbury.*

West Virginia.—The mean temperature was 70.9°; the highest was 99°, at Martinsburg on the 26th, and the lowest, 41°, at Dayton and Nuttallburg on the 22d. The average precipitation was 3.20, or about 1.00 below normal; the greatest monthly amount, 7.50, occurred at Marlinton, and the least, 0.66, at Burlington.—*C. M. Strong.*

Wisconsin.—The mean temperature was 66.7°, or about normal; the highest was 96°, at Heafford Junction on the 4th, and the lowest, 31°, at Florence on the 15th. The average precipitation was 3.88, or slightly below normal; the greatest monthly amount, 9.70, occurred at Beloit, and the least, 1.50, at Eau Claire.—*W. M. Wilson.*

Wyoming.—The mean temperature was 60.0°, or 0.2° below normal; the highest was 99°, at Fort Laramie on the 28th, and the lowest, 28°, at Four Bear on the 29th. The average precipitation was 1.68, or about normal; the greatest monthly amount, 3.02, occurred at Lander, and the least, 0.55, at Bigpiny.—*W. S. Panner.*

SPECIAL CONTRIBUTIONS.

A NEW METHOD OF OBSERVING THE DIRECTION OF MOVEMENT OF THE ATMOSPHERE.

By Mr. H. W. CLOUGH.

Under date of October 13, 1897, Mr. H. W. Clough, observer, Weather Bureau, who was then at Nashville, sent the Editor a communication from which the following interesting extract is made:

For a number of years I have been cognizant of a fact which may have an important meteorological bearing, and seems to throw light upon that mooted point in astronomy, the scintillation of the stars.

Several years ago I discovered that on holding a simple convex lens of, for example, 30 inches focus and 3 inches diameter, between the eye and a distant point of light, as an electric light at night, the lens being held at a distance of slightly less than the focal length from the eye, so that the light entirely fills the lens, there are seen horizontal undulations or streams, or rather, irregular masses of light and darkness moving swiftly across the field of view. These wave like masses vary in speed and definiteness of appearance with the position and distance of the source of light, and it was soon discovered that the direction of the undulations corresponded with the direction of the surface wind, and that it was easy to ascertain the latter within a few degrees by this means, as on pointing the lens in the direction of the wind no lateral movement of the undulations is observed, but simply a turbu-

lent motion with no particular direction. This phenomenon is probably due to air currents of varying temperature passing between the light and lens, causing variations in the light coming to the eye. I have noticed a similar phenomenon during hot windy days in summer when the "boiling" at the horizon is most pronounced. By directing a telescope at various objects in different azimuths the direction of movement of the undulations or waves of the unequally heated strata of air is seen to coincide with the direction of the wind.

As to the scintillation of stars, I have no doubt that it is in all respects similar to the undulations observed with the lens in distant points of light. In fact the electric lights in a city exhibit scintillations, the more distant ones showing them with great distinctness. These are magnified by the lens and shown to be due to air currents of different temperature causing irregular refractions of the light. The more distant the light, the slower is the apparent movement of the undulations. I have many times observed with the lens bright stars near the horizon and endeavored to ascertain the direction of movement of the undulations which are plainly visible, but the lens used was not of sufficient size to allow the direction to be made out. Probably a lens of at least 5 inches in diameter and 3 feet focus would collect enough light and present a sufficiently large surface to show the direction of the undulations. It would seem that this may have an important application in meteorology as indicating a possible method of ascertaining the direction of air currents at night; not only those near the surface, but possibly those of considerable altitude.

The preceding letter would have been published at the time had not the Editor desired to obtain a few specific observations by Mr. Clough for publication in this connection. Since that time the author has been assigned to duty in Washington, and is still pursuing the study of this interesting subject which has also attracted the attention of Messrs. Douglass and See of the Flagstaff Observatory, Ariz., whose publications in the American Meteorological Journal and various astronomical journals are well known. The whole subject of scintillation has been treated quite thoroughly in a memoir by Prof. Exner, of Vienna, and the relation between scintillation and the condition of the atmosphere was for a long time studied by Montigny of Brussels; but we believe this is the first effort to apply what is known as the "schleier method" to the determination of the general direction of movement of the atmosphere.

The "schleier method," so called by its inventor, Professor Toeppler, was first applied to the photographic study of the movements of the air around moving objects. In the hands of Professor Mach and his son, at Vienna, this has become a powerful instrument of research, applicable to many problems in meteorology and a very full exposition of the method has long since been in the hands of the Editor, awaiting a favorable opportunity for presentation to American meteorologists and physicists. Meanwhile, we trust that Mr. Clough will succeed in making his simple method practically useful to meteorology.

KITES WITHIN A THUNDER CLOUD.

By MR. THOMAS HOVENDEN.

Mr. Thomas Hovenden, who has established a kite apparatus of his own manufacture at Plymouth Meeting, Montgomery Co., Pa. (15 miles northwest of the Weather Bureau station at Philadelphia), sends the following account of a recent experience at his station:

On June 25 used a diamond cell No. 11 as pilot kite. Wind at the surface 18 to 20 miles per hour, from the southwest at first but shifting to southeast later. Diamond cell No. 10 was attached when 4,000 feet of line were out, but before the next observation (in about twenty minutes) the pilot kite entered the base of a thunder cloud that was forming and was torn from the wire, the stray line breaking. This storm did not reach the earth at the station for about forty-five minutes. All the wire and kite No. 10 were recovered. Kites Nos. 10 and 11 were exact counterparts, each having 30 square feet and being 4½ feet high, of the diamond cell pattern. The pilot kite when entering the thunder cloud at its base shifted toward east of southeast, while the lower kite was pulling in an almost opposite direction. Electric shocks were slight except after the kite reached 4,500 feet when they were strong, forming a continuous arc about 3 inches long, with sparks, now and then, about an inch long. The height of the pilot kite when it entered the thunder cloud was about 4,200 feet, and the wire was still being paid out fast enough to scorch the brake ropes of the reel. When the pilot kite was torn away the thermometer also sailed off into the next county. I have lately made and flown a 14-foot kite, having 216 square feet of surface. I append the record of the flight of June 25 which ends with the reading at 3:50, or about twenty minutes before the pilot kite was torn away; of course the temperature record of the kite was lost.

Kite observations, June 25, at Plymouth Meeting, Pa.

Time.	Length of line.		Angular elevation of kite.	Azimuth of kite.	Pull.	Inclination of wire at reel.	Corrected elevation of kite.	Surface conditions.		Wind direction.
	Dial.	Feet.						Wet bulb.	Dry bulb.	
h. m.			°	°	Lbs.	°	Feet.	° F.	° F.	
2 45	240	1,320	43	20 e. of n.	28	35	890	79	84	sw.
2 55	363	2,000	42	25 e. of n.	24	25	1,807	77	81	sw.
3 15	636	3,500	42	35 e. of n.	32	15	2,236	78	89	sw.
3 25	636	3,500	35	35 e. of n.	20	20	1,963	77	83	sw.
3 50	727	4,000	31	50 e. of n.	30	15	2,029	79	90	se.

The fact that the lower kite and the wire at the reel veered steadily more and more to the right as the lower kite ascended

is here beautifully shown. The further and extremely great veering of the upper or pilot kite, by which it was deflected to the east of southeast at about 4 p. m., while the lower kite pulled toward the northwest, shows that the lower southeast wind was at this time and in this portion of the thunderstorm overlaid by an upper northwest wind.

METEOROLOGICAL EXTREMES AT NORTHFIELD, MASS.

By MR. A. D. ELMER, JR.

[Mr. A. D. Elmer, of Northfield, Mass., communicates the following collection of interesting meteorological events at that place, which may serve as a slight extension of the very interesting work, by Sidney Perley, entitled "Historic Storms of New England," published at Salem in 1891. In some cases Mr. Elmer has omitted the full reference to the proper authority from which the record is copied, but, in general, the items have all been verified.—Ed.]

1815. September 23, great September gale; the only authentic West Indian hurricane in New England; passed between Providence and New London and, via Worcester and Connecticut River Valley, to the St. Lawrence River west of Montreal. From "Our First Century. By R. M. Devens. C. A. Nichols & Co., Springfield, Mass.; A. H. Walker, Columbus, Ohio. 1877." Pierce "On the Weather" notes a northeast gale at Philadelphia, September 22.

1816. A cold summer; ice every month of the year and heavy snow in June. These items, from old records, refer to the memorable year 1816, when there was no summer either in this country or in England and nearly every green thing was destroyed. For fuller details see Pierce "On the Weather" and Perley "Historic Storms."

1821. Great whirlwind on June 30. This quotation from an old book reminds one of the tornadoes in New Hampshire and Massachusetts, September 9, 1821. For fuller accounts see Perley's Historic Storms.

1866. June 7, a cloudburst. Quoted from Temple and Sheldon's History of Northfield.

1869. October. Worst floods on record, particularly in the Connecticut River. Quoted from a local diary kept by A. D. Elmer, sr., and refers especially to Northfield, as equally heavy floods have occurred in the lower Connecticut.

1881. October 14, at Central Vermont Railroad station, maximum temperature 92°.

1885. March 18, minimum temperature -20°.

1887. August 18, windrush from the southwest, or a western tornado. (This and all subsequent notes are from manuscript meteorological records kept by Mr. Elmer at Northfield.)

1888. February 14, maximum 49°; February 16, minimum -29°; February 17, maximum 39°. There was, therefore, a fall of 78° in forty hours, followed by a rise of 68° in thirty-two hours.

1888. March 11-14, deepest snowfall viz, 2 feet 6 inches.

1896. April 16, maximum temperature 96.5°; September 23, 9 p. m., temperature 31°; September 24, 2 a. m., minimum temperature 27°; summer temperature in the vicinity of or warmer than 90° on sixty-four days; during a hot spell in August 100° was recorded twice; 100° recorded three times during season; weather driest on record April to August, inclusive, except for the extra rainfall of July; first drought, eight weeks; general deficiency of the five months, one-third (excess of July one-half); first drought unbroken five weeks; December 25, -15°; December 28, -16°.

1897. January 28, snowfall 18 inches; estimated velocity maximum wind gusts, 60 miles; April 19, 1 p. m., strong south gale, clear, temperature 71°; 8 p. m., strong northwest gale, clear, temperature 29°; April 20, 5 a. m., strong north wind, clear, temperature 16°; fall, 42° in seven hours, 56° in sixteen hours; summer temperature July 1 (only two